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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Fufang Zha et al.
Serial No:	10/774,041
Confirmation No:	4995
Filed:	February 6, 2004
For:	METHOD OF CLEANING MEMBRANE MODULES
Examiner:	Krishnan S. Menon
Art Unit:	1723

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/Nicole A. Palmer/
Nicole A. Palmer

Commissioner for Patents
Alexandria, VA 22313-1450

APPELLANT'S REPLY BRIEF PURSUANT TO 37 C.F.R. § 41.41(a)(1)

This Reply Brief is submitted in response to the Examiner's Answer mailed June 12, 2007 in the above-referenced application.

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I. Reply Brief Identification

Appellant:	Fufang Zha et al.
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II. Status of Claims (37 C.F.R. § 41.37(c)(1)(iii))

Claims 1-24 were pending in the application as filed on February 6, 2004. In an Amendment filed on July 17, 2006, claims 1, 2, 5-8, 10, 11 and 13 were amended, claims 14-24 were canceled without prejudice or disclaimer, and new claim 25 was added. Claims 1-13 and 25 stand rejected, with claim 1 being in independent form. Claims 1-13 and 25 are being appealed herein.

III. Grounds of Rejection to Be Reviewed on Appeal (37 C.F.R. § 41.37(c)(1)(vi))

Whether each of claims 1-13 and 25 is unpatentable over either Sunaoka et al. (hereinafter "Sunaoka") (U.S. 5,209,852) or Beck et al. (hereinafeter "Beck") (U.S. 6,159,373).

IV. Argument (37 C.F.R. § 41.37(c)(1)(vii))

For the reasons provided below, the Examiner's rejections are improper and should be reversed. Each of claims 1-13 and 25, as presented, is allowable.

A. Claims 1-13 and 25 are patentable over Sunaoka

Claims 1-13 and 25 were rejected under 35 U.S.C. § 102(b) as being anticipated by, or, in the alternative, under 35 U.S.C. § 103(a), as being obvious over Sunaoka.

As previously discussed, Sunaoka fails to disclose, teach or suggest a method for cleaning a membrane filtration module as recited in independent claim 1. Claim 1 recites, in part, steps of forming a gas-containing region on the first side of the permeable wall, sealing the feed-containing vessel, pressurizing a gas within the gas-containing region, and opening the feed-containing vessel to atmosphere, whereby the gas-containing region expands and produces a sweep of the feed-containing vessel to remove the liquid containing the dislodged contaminant.[1]

Sunaoka discloses a two-stage process for membrane cleaning aimed at preventing exfoliated solids from roughening outer surfaces of the membranes. (See Sunaoka at col. 5, lines 27-31.) A preliminary drain down is carried out to discharge waste water containing dislodged fine particles before second-stage scrubbing, or, alternatively, simultaneously with first-stage scrubbing. The drain step is generally executed by gravity via open valve 21, and may be facilitated by a water head or compressed air. (See Sunaoka at col. 8, line 45 through col. 9, line 6; col. 10, lines 3-17.) More specifically, Sunaoka states that the pressure of supplied compressed air may be utilized to effect quick draining of the waste water. (See Sunaoka at col. 9, lines 4-6.) Sunaoka fails, however, to disclose or suggest any method for effecting a high velocity drain down to remove accumulated solids, such as that presently recited. Sunaoka discloses only that the drain rate can be adjusted with valve 21 and that it is "preferably adjusted such that the waste water in the lower compartment R is drained therefrom in a relatively short time." (See Sunaoka at col. 10, lines 28-35).

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[1] Appellant wishes to address a recurring inaccuracy in the Examiner's description of the method of the present invention. (See Examiner's Answer at page 11, lines 1-6; page 14, lines 7-13; page 20, lines 16-20.) Use of filtrate or permeate water is disclosed at [0035] of corresponding U.S. Patent Application Serial No. 2004/0217053 as "another way to create such a gas pocket" and therefore the present method is not limited by slow pressurization as repeatedly asserted in the Examiner's Answer.

Sunaoka does not teach or suggest a method involving pressurizing a gas within a gas-containing region on the feed side of the permeable membrane wall. Even assuming *arguendo* that any compressed air supplied by Sunaoka to the tank inherently forms a gas-containing region in the tank, Sunaoka still fails to disclose pressurizing a gas within the gas-containing region as required by independent claim 1. Indeed, any compressed air supplied by Sunaoka has necessarily been pre-pressurized, and will only depressurize upon introduction into the tank as the waste water level drops via open valve 21.[2] The fact that pressurized gas is supplied to the vessel does not imply that the system is sealed for pressurizaton; the Sunaoka system does not "hold the pressure" as asserted by the Examiner. (See Examiner's Answer at page 6, lines 11-13; page 13, lines 7-9.) With regard to any manipulation of valve 21 between open and closed positions for pressurization, the Examiner's assertion that "one would utilize these steps particularly to obtain the full force of compressed air to drain the liquid fast" is improper in that it uses hindsight gleaned only from Appellant's own disclosure.[3] (See Examiner's Answer at page 13, lines 16-21; page 14, lines 16-19; page 15, lines 5-9.) Instead, as disclosed by Sunaoka, the pressure of any compressed air introduced simply facilitates the purging of waste water via open valve 21.

Furthermore, because Sunaoka does not disclose pressurizing a gas within a gas-containing region, Sunaoka cannot teach or suggest a method whereby the gas-containing region expands and produces a sweep of the feed-containing vessel to remove the liquid containing the dislodged contaminant when the feed-containing vessel is opened to atmosphere. The Examiner summarily oversimplifies the method recited in independent claim 1 by equating it with the "quick drain" technique as disclosed by Sunaoka. (See Examiner's Answer at page 13, line 23 to

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[2] The Examiner's assertion that "there is no teaching or suggestion in Sunaoka for one to conclude that the valve should be open before commencing pressurization with compressed air either" is misleading. (See Examiner's Answer at page 16, lines 12-13.) To the contrary, there is no teaching or suggestion in Sunaoka for one to conclude that the valve should be *closed* before introduction of any compressed air.

[3] Despite the Examiner's assertions that Appellant's claims do not recite the criticality of having the drain valve closed before commencing pressurization, the Examiner does recognize that "Appellant's disclosed process therefore requires the drain valve closed to attain sufficient air pressure in a large-enough air space for making the sweep flow possible." (See Examiner's Answer at page 11, lines 6-8.) (See also Examiner's Answer at page 14, lines 7-8 ("having the drain valve closed is critical for the appellant's disclosed process because of the reasons described above") versus Examiner's Answer at page 15 lines 3-5, 21-22.) Regardless, Appellant does not rely upon the sequence of recited method steps for patentability. (See Examiner's answer at page 15, lines 10-12.)

page 14, line 1.) The present invention clearly differs from Sunaoka by developing a compressed air region with the tank sealed prior to drain down, to generate both a blowout effect on the membrane pores and a high velocity sweep of the vessel when the tank is opened to atmosphere for improved cleaning efficiency. Notably, the Examiner highlights this distinction by quoting Sunaoka at col. 9, lines 1-6 which clearly states that the pressure of the compressed air *charged* into the filter column is utilized to effect quick draining of the wastewater, rather than any pressure established within the vessel itself. (See Examiner's Answer at page 13, lines 1-6.)

Because Sunaoka does not disclose, teach or suggest pressurizing a gas within a gas-containing region, and opening the feed-containing vessel to atmosphere, whereby the gas-containing region expands and produces a sweep of the feed-containing vessel to remove the liquid containing the dislodged contaminant, independent claim 1 is patentable over the teaching of Sunaoka. Claims 2-13 and 25 depend from claim 1 and are likewise patentable over the teaching of Sunaoka for at least the same reasons.

B. Claims 1-4, 9-13 and 25 are patentable over Beck

Claims 1-4, 9-13 and 25 were rejected under 35 U.S.C. § 103(a) over U.S. Patent No. 6,159,373 to Beck.

As previously discussed, Beck discloses a method of removing retained species from a membrane module upon termination of a concentration cycle. Clarified liquid remaining in the membrane lumens is removed, and high pressure compressed gas is then introduced through inlet 18 and the lumens of the fibers 12. The still liquid-filled shell is sealed, and a reservoir of high pressure gas is accumulated in the fiber lumens because the liquid in the shell is relatively incompressible thus preventing gas from penetrating the porous walls.[4] (See Beck at col. 5, lines 13-25). The shell outlet 17 is then opened, resulting in an explosive decompression of the pressurized gas through the fiber walls and causing dislodgment of foulants. (See Beck at col. 5, lines 26-31).

[4] Beck states that because the feed side of the tank is full of incompressible liquid and the lumen of the membrane is pressurized with gas, gas will not move through the membrane pores until the feed side is opened. The merits of the Examiner's assertions regarding "the principle of hydraulics and the Bernoulli principle" are not explored herein.

Beck creates a compressed gas containing region within the lumen rather than on the feed-side of the membrane wall as presently recited. Thus, the Examiner inaccurately summarizes the differences between Beck and the present invention by simply stating "the difference is that Beck uses compressed air, whereas appellant discloses pressurizing with liquid permeate." (See Examiner's Answer at page 18, lines 5-6.) Even assuming *arguendo* that a gas-containing region forms on the feed side of Beck, Beck still does not disclose, teach or suggest pressurizing a gas in a gas-containing region on the feed-side of the permeable wall whereby the gas-containing region expands and produces a sweep of the feed-containing vessel to remove the liquid containing dislodged contaminant as presently recited. (See Examiner's Answer at page 19, line 4 to page 20, line 6.) Beck is concerned with dislodging solids within and/or on the fiber walls, rather than draining liquid containing dislodged contaminant matter. (See Beck at Abstract; col. 1, lines 63-67; col. 2, lines 16-18; col. 5, lines 26-31.) Indeed, Beck states that it is preferable to create liquid/fluid turbulence around the membrane pores by *supplying* feed liquid into the shell side of the filter while fluid pressure is still being applied to the membrane lumens. (See Beck at col. 2, lines 14-18.) The only disclosure made by Beck with regard to managing dislodged contaminant involves a step of "washing dislodged contaminant matter away by the application of a flow of liquid over the external surface of said fiber walls." (See Beck at col. 2, lines 1-3, 60-62.)

The proposed modification of the Beck process to instead pressurize the feed side of the membrane is improper because it would change a fundamental principle under which the Beck regime is intended to operate. (In re Ratti, 270 F.2d 810, 123 USPQ 349 (CCPA 1959).) Nor would such a modification have been obvious to one of ordinary skill in the art. Unlike the Beck process, the present invention offers the benefit that the liquid need not be removed from the lumens during drain down, resulting in avoiding having to re-wet the membranes when recommencing filtration. (See Beck at col. 3, lines 51-54.) Further, unlike the Beck process, the present invention is not limited to membranes with pores capable of closing rapidly to reseal holes, and a base material capable of not cracking by work hardening and remaining within its modified elastic limit. (See Beck at col. 3, lines 31-34.)

Because Beck does not disclose, teach or suggest pressurizing a gas in a gas-containing region on the feed-side of the permeable wall, independent claim 1 is patentable over the

teaching of Beck. Claims 2-4, 9-13 and 25 depend from claim 1 and are likewise patentable for at least the same reasons.

C. Closing

In view of the above, the rejections over both Sunaoka and Beck are improper. Because no proper *prima facie* case of obviousness has been established, Appellant respectfully requests reversal of the rejections and allowance of the claims.

V. Claims Appendix (37 C.F.R. § 41.37(c)(1)(viii))

1. (Previously Presented) A method for cleaning a membrane filtration module, the module comprising at least one membrane located in a feed-containing vessel, the membrane comprising a permeable wall, the method comprising:

conducting a filtration operation wherein a feed is applied to a first side of the permeable wall and a filtrate is withdrawn from a second side of the permeable wall;

suspending the filtration operation;

performing a cleaning process on the permeable wall to dislodge a contaminant therefrom into a liquid surrounding the membrane;

forming a gas-containing region on the first side of the permeable wall;

sealing the feed-containing vessel;

pressurizing a gas within the gas-containing region; and

opening the feed-containing vessel to atmosphere, whereby the gas-containing region expands and produces a sweep of the feed-containing vessel to remove the liquid containing the dislodged contaminant.

2. (Previously Presented) The method according to claim 1, wherein the step of performing a cleaning process comprises performing a fluid backwash of the permeable wall.

3. (Original) The method according to claim 2, wherein the fluid backwash comprises a liquid backwash.

4. (Original) The method according to claim 2, wherein the fluid backwash comprises a gas backwash.

5. (Previously Presented) The method according to claim 1, wherein a velocity of the sweep is greater than about 0.03 m/sec.

6. (Previously Presented) The method according to claim 1, wherein a velocity of the sweep is from about 0.3 m/sec to about 2.0 m/sec.

7. (Previously Presented) The method according to claim 1, wherein the step of performing a cleaning process comprises gas scrubbing a surface of the permeable wall.

8. (Previously Presented) The method according to claim 1, wherein the sweep of the feed-containing vessel is produced periodically in different directions within the vessel.

9. (Original) The method according to claim 1, wherein the membrane comprises a hollow fiber membrane, and wherein the filtrate is withdrawn from at least one end of the hollow fiber membrane during the filtration operation.

10. (Previously Presented) The method according to claim 1, wherein the gas-containing region is formed within the feed-containing vessel.

11. (Previously Presented) The method according to claim 1, wherein the gas-containing region is formed within a further vessel coupled to the feed-containing vessel; and wherein the step of sealing the feed-containing vessel comprises sealing the feed-containing vessel and the further vessel as a whole.

12. (Original) The method according to claim 10, wherein the gas-containing region is formed by partially draining down a feed liquid within the feed-containing vessel.

13. (Previously Presented) The method according to claim 10, wherein opening the feed-containing vessel comprises applying a fluid backwash to the membrane.

14-24. (Canceled)

25. (Previously Presented) The method according to claim 1, wherein the feed-containing vessel is opened to atmosphere when a pressure on the first side of the membrane approaches a pressure on the second side of the membrane to generate an instantaneous negative transmembrane pressure.

VI. Conclusion

For the reasons provided above, the rejections are improper and should be reversed. Appellant respectfully requests reversal of the rejections and issuance of a Notice of Allowance.

If there is any fee occasioned by this filing, including an extension fee that is not covered by an accompanying payment, please charge any deficiency to Deposit Account No. 50/2762, Ref. No. M2019-701920.

Respectfully submitted,
Fufang Zha et al., Appellant

/Nicole A. Palmer/
Peter C. Lando, Reg. No. 34,654
Nicole A. Palmer, Reg. No. 58,943
LOWRIE, LANDO & ANASTASI, LLP
One Main Street
Cambridge, Massachusetts 02142
Tel. (617) 395-7000

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